

ESTOIH STUDY* SUMMARY

ESTOIH¹⁻⁴ study examined the impact of the short-stitch technique for midline abdominal closure on the incidence of incisional hernia(IH). The study compared the short-stitch technique against the standard loop closure using Monomax®.

* ESTOIH

Effect of the Suture Technique on the Occurrence of Incisional Hernia.

Table 1. Incisional hernia rate 1 year follow-up

Technique	IH rate – 1 year follow-up ³	p-value
long-stitch	6.4 % (13/204)	0.173
short-stitch	3.3 % (7/210)	

p>0.05;no statistically significant difference observed

Table 2. Incisional hernia rate 3 years follow-up

Technique	IH rate – 3 years follow-up ⁴	p-value
long-stitch	10.45 % (21/201)	0.136
short-stitch	7.58 % (15/198)	

p>0.05;no statistically significant difference observed

Table 3. Incisional hernia rate 5 years follow-up

Technique	IH rate – 5 years follow-up ⁵	p-value
long-stitch	13.90 % (26/187)	0.155
short-stitch	9.14 % (16/175)	

p>0.05;no statistically significant difference observed

"Although the IH rate increases over time, within each period, short-stitch technique consistently exhibits a lower IH rate than long-stitch technique.

These low complication rates can be attributed to the properties of Monomax. The ESTOIH results support the use of Monomax in combination with short-stitch technique for abdominal wall closure"



Effects of the short-stitch Technique for Midline Abdominal Closure on Incisional Hernia. Results from the Randomised-Controlled ESTOIH Trial²⁻⁵

The short-stitch technique for fascial closure after midline laparotomy has been shown to reduce the incidence of incisional hernias one year postoperatively compared to the traditional large-bite technique. However, most studies evaluating this approach have been limited to a one-year follow-up period.^{6,7}

Initiated in 2013, ESTOIH trial was the only randomized controlled study.

Rationale

Continuous suture technique with a suture to wound length ratio of at least 4:1, using an extra-long-term absorbable, elastic monofilament suture material, is recommended for primary median laparotomy closure. In this sense, ESTOIH trial addresses the comparison of short vs long-stitch technique using Monomax[®] to investigate the effects of the short-stitch technique on hernia development, compared to traditional loop closure of midline laparotomy.

Monomax[®] is an extra-long-term absorbable, synthetic, elastic monofilament dyed violet which intended purpose is soft tissue approximation in abdominal fascial closure. Monomax[®] is produced from poly (4-hydroxybutyrate) polymer.

Table 4. ESTOIH study design data



9 centres
in Germany
and Austria



30 days,
1 year, 3 years
and 5 years



425 patients



Elective primary
laparotomy with an
incision $\geq$ 15 cm

Parameter	long-stitch (n=215)	short-stitch (n=210)
Suture Material	Monomax® 1, 150 cm loop, HR48	Monomax® 2/0, 150 cm, HR26
Stitch interval	10 mm	5 mm
Median wound to stitch site distance	10 mm	5 - 8 mm
Suture / wound length ratio	4:1	$\geq$ 5:1
Knots (recommended)	At least 6 knots at the end of the suture line.	A self-locking knot at the beginning and at the end of the suture line.

Monomax[®] is characterized by properties that may support fascial closure:

- The increased elasticity might help to reduce the occurrence of button-hole hernia at the wound edges and reduces tension on the fascia.^{2,3}
- The delayed resorbability of the suture material is thought to support scar formation and wound healing over time, leading to fewer delayed hernias.³
- In summary, Monomax[®] suture material seems to support the healing of the fascia by its high elasticity, high basic strength retention and long-lasting resorption time.²

Table 5. Reported rates of incisional hernia (IH) and surgical site infection (SSI) in the literature

STUDY	IH rate – 1 year Follow-Up			SSI rate 30 days Follow-Up		
	long-stitch	short-stitch	p-value	long-stitch	short-stitch	p-value
MILLBOURN ⁴	18 %	5.6 %	<0.001*	10.5 %	5.2 %	0.02*
STITCH ⁵	21 %	13 %	0.022*	24 %	21 %	0.419
ESTOIH ^{2,3}	6.4 %	3.3 %	0.173	Sup ^{**} : 5.24 % Deep: 0.48 % Total: 5.71 %	Sup ^{**} : 3.26 % Deep: 0.47 % Total: 3.72 %	Sup ^{**} : 0.34 Deep: 1.0

* p<0.05; statistically significant difference; **Sup: superficial
* This cross-study comparisons should be interpreted with caution due to differences in study design, patient populations and study conduct.
* Further details on the data presented in Table 5 have been published by Fortelny RH, Dietz U. Narbenhernien: Epidemiologie, Evidenz und Leitlinien. Chirurgie (Heidelb). 2024 Jan;95(1):3–9.

The low IH rate in the ESTOIH study stands out with previously published data. The SSI rate was remarkably low as well across treatment groups compared to the Millbourn⁴ and STITCH⁵ studies.
ESTOIH study did not find direct correlation between wound infections and the occurrence of IH.

Key Notes

- **ESTOIH study reported low SSI and IH rates** in the short and long-stitch group.^{1,2}
- These low complication rates can be attributed to the properties of the **Monomax® suture material**.^{1,2}
- ESTOIH study shows for the first time that using **Monomax® helps to reduce the rate of IH and other complications** despite using traditional long-stitch technique.^{2,3}
- **After 5years the IH incidence increased, but the IH rates were lower in the short-stitch group** compared to the long-stitch group.⁶

CONCLUSIONS

The short-stitch technique consistently showed lower incisional hernia rates than the long-stitch technique throughout follow-up (1-,3-,and 5 years).

1 Albertsmeier M, Hofmann A, Baumann P, Riedl S, Reisensohn C, Kewer JL et al. Effects of the short-stitch technique for midline abdominal closure: short-term re- sults from the randomised-controlled ESTOIH trial. Hernia. 2022 Feb;26(1):87-95.
2 Fortelny RH, Andrade D, Schirren M, Baumann P, Riedl S, Reisensohn C et al. Effects of the short stitch technique for midline abdominal closure on incisional hernia (ESTOIH): randomized clinical trial. Br J Surg. 2022 Aug;109(9):839-845.
3 Fortelny RH, Hofmann A, Baumann P, Riedl S, Kewer JL, Hoelderle J, et al. Three-year follow-up analysis of the short-stitch versus long-stitch technique for elective midline abdominal closure randomized-controlled (ESTOIH) trial. Hernia. 2024; 28(4):1283-1291.
4 Millbourn D, Cengiz Y, Israelsson LA. Effect of stitch length on wound complications after closure of midline incisions: a randomized controlled trial. Arch Surg 2009;144(11):1056–1059.
5 Deerenberg EB, Harlaar JJ, Steyerberg EW, Lont HE, van Doorn HC, Heisterkamp J et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomized controlled trial. Lancet 2015;386(10000):1254–1260.
6 Fortelny RH, Baumann P, Hofmann A, Riedl S, Kewer JL, Hoelderle J, et al. 5-year clinical outcome of the ESTOIH trial comparing the short-bite versus large-bite technique for elective midline abdominal closure. Hernia. 2025;29:263.



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